

We Claim:

1. A composition comprising a functionalized C3 to C40 olefin polymer  
olefin polymer comprising at least 50 mol% of one or more C3 to C40  
olefins, and where the olefin polymer, prior to functionalization, has:
  - 5           a) a Dot T-Peel of 1 Newton or more on Kraft paper;
  - b) an Mw of 10,000 to 100,000; and
  - c) a branching index (g') of 0.98 or less measured at the Mz of  
                the polymer when the polymer has an Mw of 10,000 to  
                60,000, or
  - 10           a branching index (g') of 0.95 or less measured at the Mz of the  
polymer when the polymer has an Mw of 10,000 to 100,000; and  
where the C3 to C40 olefin polymer comprises at least 0.001 weight % of  
a functional group.
- 15   2. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to  
functionalization, has:
  - a) a Dot T-Peel of 1 Newton or more on Kraft paper;
  - b) a branching index (g') of 0.98 or less measured at the Mz of  
                the polymer;
  - 20           c) a Mw of 10,000 to 60,000; and
  - d) a heat of fusion of 1 to 50 J/g.
- 25   3. The composition of claim 1, where the C3 to C40 olefin polymer, prior to  
functionalization, is a homopolypropylene or a copolymer of propylene and  
up to 5 mole% ethylene having:
  - a) an isotactic run length of 1 to 30,
  - b) a percent of r dyad of greater than 20%, and
  - c) a heat of fusion of between 1 and 70 J/g.
- 30   4. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to  
functionalization, comprises propylene and less than 15 mole % of ethylene.

5. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has a melt viscosity of 7000 mPa•sec or less at 190°C.
- 5 6. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has a melt viscosity of 5000 mPa•sec or less at 190°C.
7. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has a melt viscosity of between 250 and 6000 mPa•sec at 190°C.
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8. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has a melt viscosity of between 500 and 3000 mPa•sec at 190°C.
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9. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has a Tg of 0°C or less.
- 20 10. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has a Tg of -10°C or less.
11. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has an Mw of 10,000 to 75,000 and a branching index of 0.6 or less.
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12. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has an Mw of 10,000 to 50,000 and a branching index of 0.7 or less.

13. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has an Mw of 10,000 to 30,000 and a branching index of 0.98 or less.
- 5 14. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has a branching index (g') of 0.90 or less measured at the Mz of the polymer.
- 10 15. The composition of claim 1, wherein the SEC graph of the C3 to C40 olefin polymer, prior to functionalization, is bi- or multi-modal.
16. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has an amorphous content of at least 50%.
- 15 17. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has
- a) a peak melting point between 60 and 190°C;
  - b) a heat of fusion of 0 to 70 J/g; and
  - c) a melt viscosity of 8000 mPa•sec or less at 190°C.
- 20 18. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has:
- a) a Tg of -10°C or less;
  - b) a melt viscosity between 2000 and 6000 mPa•sec;
  - 25 c) a molecular weight distribution (Mw/Mn) of at least 5; and
  - d) a bi- or multi-modal SEC graph of the polymer.
19. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has a crystallinity of at least 5%.

20. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has 20 wt.% or more of hexane room temperature soluble fraction and 50 wt % or less of Soxhlet heptane insolubles.
- 5 21. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, comprises less than 3.0 mole % ethylene.
22. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, comprises less than 1.0 mole % ethylene.
- 10 23. A composition comprising the composition of claim 1 and a functionalized wax.
24. A composition comprising the composition of claim 1 and a wax.
- 15 25. A composition comprising the composition of claim 1 and a hydrocarbon resin.
- 20 26. The composition of claim 1 wherein the functional group is present at 0.005 to 50 weight % of the C3 to C40 olefin polymer.
27. The composition of claim 1 wherein the functional group is present at 1 to 20 weight % of the C3 to C40 olefin polymer.
- 25 28. The composition of claim 1 wherein the unsaturated group comprises maleic acid and or maleic anhydride.
29. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has an Mz/Mn of 2 to 200.
- 30 30. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has an Mz of 15,000 to 500,000.

31. The composition of claim 1 wherein the composition has a SAFT of 50 to 150°C.
- 5 32. The composition of claim 1, wherein the composition has a Shore A hardness of 95 or less.
33. The composition of claim 1, wherein the composition has a set time of 5 seconds or less.
- 10 34. The composition of claim 1, wherein the C3 to C40 olefin polymer, prior to functionalization, has an Mw/Mn of 2 to 75.
- 15 35. The composition of claim 1, wherein the C3 to C40 olefin polymer is functionalized with an unsaturated carboxylic acid, an ester of an unsaturated carboxylic acid, an acid anhydride, a di-ester, a salt of an unsaturated carboxylic acid, an unsaturated amide, an unsaturated imide, an aromatic vinyl compound, a hydrolyzable unsaturated silane compound, an unsaturated halogenated hydrocarbon, or a combination thereof.
- 20 36. The composition of claim 1, wherein the C3 to C40 olefin polymer is functionalized with one or more of maleic anhydride, citraconic anhydride, 2-methyl maleic anhydride, 2-chloromaleic anhydride, 2,3-dimethylmaleic anhydride, bicyclo[2,2,1]-5-heptene-2,3-dicarboxylic anhydride, 4-methyl-4-cyclohexene-1,2-dicarboxylic anhydride, acrylic acid, 25 methacrylic acid, maleic acid, fumaric acid, itaconic acid, citraconic acid, mesaconic acid, crotonic acid, bicyclo(2.2.2)oct-5-ene-2,3-dicarboxylic acid anhydride, 1,2,3,4,5,&g, lo-octahydronaphthalene-2,3-dicarboxylic acid anhydride, 2-oxa-1,3-diketospiro(4.4)non-7-ene, bicyclo(2.2.1)hept- 5-ene-2,3- dicarboxylic acid anhydride, maleopimaric acid, tetrahydrophtalic 30 anhydride, norborn-5-ene-2,3-dicarboxylic acid anhydride, nadic anhydride, methyl nadic anhydride, himic anhydride, methyl himic

anhydride, x-methyl-bicyclo(2.2.1)hept-5-ene-2,3- dicarboxylic acid  
anhydride (XMNA), methyl acrylate, ethyl acrylate, butyl acrylate, methyl  
methacrylate, ethyl methacrylate, butyl methacrylate, vinyltrichlorosilane,  
vinyltris(beta-methoxyethoxy)silane, vinyltriethoxysilane,  
5 vinyltrimethoxysilane, gamma-methacryloxypropyltrimethoxysilane  
monovinylsilane, monoallylsilane, vinyl chloride, or vinylidene chloride.

- 10 37. The composition of claim 1, wherein the functional group is maleic  
anhydride.
38. The composition of claim 1, wherein the composition further comprises  
another polymer.
- 15 39. The composition of claim 38, wherein the polymer comprises an olefin  
homopolymer or copolymer that is not functionalized.
40. The composition of claim 38, wherein the polymer comprises an olefin  
homopolymer or copolymer that comprises a different functional group or  
groups.
- 20 41. The composition of claim 38, wherein the polymer comprises a  
functionalized C3 to C40 olefin polymer that comprises a different amount  
of the same functionalized group.
- 25 42. The composition of claim 38, wherein the polymer comprises an alpha-  
olefin homopolymer comprising ethylene, C4 to C20 alpha olefins, or a  
combination thereof.
- 30 43. The composition of claim 38, wherein the polymer is selected from the  
group consisting of ethylene propylene rubber, ethylene propylene diene  
monomer rubber, styrenic block copolymer rubber, butyl rubber, halobutyl  
rubber, copolymers of isobutylene and para-alkylstyrene, halogenated

copolymers of isobutylene and para-alkylstyrene, natural rubber, polyisoprene, copolymers of butadiene with acrylonitrile, polychloroprene, alkyl acrylate rubber, chlorinated isoprene rubber, acrylonitrile chlorinated isoprene rubber, polybutadiene rubber or a combination thereof.

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44. The composition of claim 38, wherein the polymer is selected from the group consisting of isotactic polypropylene, highly isotactic polypropylene, syndiotactic polypropylene, random copolymer of propylene and ethylene and/or butene and/or hexene, polybutene, ethylene vinyl acetate, low density polyethylene (density 0.915 to less than 0.935 g/cm<sup>3</sup>) linear low density polyethylene, ultra low density polyethylene (density 0.86 to less than 0.90 g/cm<sup>3</sup>), very low density polyethylene (density 0.90 to less than 0.915 g/cm<sup>3</sup>), medium density polyethylene (density 0.935 to less than 0.945 g/cm<sup>3</sup>), high density polyethylene (density 0.945 to 0.98 g/cm<sup>3</sup>), ethylene vinyl acetate, ethylene methyl acrylate, copolymers of acrylic acid, polymethylmethacrylate, polyvinylchloride, polybutene-1, isotactic polybutene, ABS resins, polyamides, polycarbonates, PET resins, crosslinked polyethylene, copolymers of ethylene and vinyl alcohol (EVOH), polymers of aromatic monomers such as polystyrene, poly-1 esters, polyacetal, polyvinylidene fluoride, polyethylene glycols and/or polyisobutylene.

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45. The composition of claim 38, wherein the polymer is selected from the group consisting of metallocene polyethylenes or metallocene polypropylenes.

46. The composition of claim 1 wherein the composition further comprises a non-functionalized C3 to C40 olefin polymer comprising at least 50 mol% of one or more C3 to C40 olefins, and where the olefin polymer has:

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- a) a Dot T-Peel of 1 Newton or more on Kraft paper;
- b) an Mw of 10,000 to 100,000; and



c) a branching index (g') of 0.98 or less measured at the Mz of the polymer when the polymer has an Mw of 10,000 to 60,000, or a branching index (g') of 0.95 or less measured at the Mz of the polymer when the polymer has an Mw of 10,000 to 100,000.

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47. The composition of claim 46, wherein the non-functionalized C3 to C40 olefin polymer has an amorphous content of at least 50% and a crystallinity of at least 5%.

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48. The composition of claim 46, wherein the non-functionalized C3 to C40 olefin polymer has a crystallinity of at least 20%.

49. The composition of claim 46, wherein the non-functionalized C3 to C40 olefin polymer has:

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- a) a Dot T-Peel of 1 Newton or more on Kraft paper;
- b) a branching index (g') of 0.98 or less measured at the Mz of the polymer;
- c) a Mw of 10,000 to 60,000; and
- d) a heat of fusion of 1 to 50 J/g.

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50. The composition of claim 46, where the non-functionalized C3 to C40 olefin polymer is a homopolypropylene or a copolymer of propylene and up to 5 mole% ethylene having:

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- a) an isotactic run length of 1 to 30,
- b) a percent of r dyad of greater than 20%, and
- c) a heat of fusion of between 1 and 70 J/g.

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51. The composition of claim 46, wherein the non-functionalized C3 to C40 olefin polymer has a melt viscosity of 5000 mPa•sec or less at 190°C.

52. The composition of claim 46, wherein the non-functionalized C3 to C40 olefin polymer has an amorphous content of at least 50%.



53. The composition of claim 46, wherein the non-functionalized C3 to C40 olefin polymer has a crystallinity of at least 5%.
- 5 54. The composition of claim 1, further comprising about 0.1 to about 50 wt% of a tackifier, a filler, an antioxidant, an adjuvant, an adhesion promoter, an oil, a plasticizer, a block, an antiblock, a pigment, a processing aid, a UV stabilizer, a neutralizer, a lubricant, a surfactant, a nucleating a coupling agent, a color master batch, a polymer having a Mn below 5000,  
10 a polar wax, a non-polar wax, a functionalized wax, a polypropylene wax, a polyethylene wax, a wax modifier, an elastomer, an impact copolymer, an ester polymer, a crosslinking agent, or a combination thereof.
- 15 55. The composition of claim 1, wherein the Gardner color of the composition that has been heat aged at 180 °C for 48 hours does not change by more than 7 Gardner units as compared to the Gardner color of the composition prior to being heat aged.
- 20 56. The composition of claim 1, wherein the Gardner color of the composition that has been heat aged at 180 °C for 48 hours does not change by more than 4 Gardner units as compared to the Gardner color of the composition prior to being heat aged.
- 25 57. The composition of claim 1, wherein the amount of free acid groups present in component 2 is less than about 1000 parts per million, based on the total amount of functionalized C3 to C40 olefin polymer present.
58. The composition of claim 1, which is essentially free from phosphites.
- 30 59. The composition of claim 1, the C3 to C40 olefin polymer comprising at least 0.001 to 50 weight % functional group has been washed with an

organic solvent, with an aqueous solution, with an acidic solution, with a basic solution, or a combination thereof.

- 5 60. The composition of claim 1, wherein the functional group comprises maleic anhydride and the at least a portion of the polymer has been washed with a basic solution.
- 10 61. The composition of claim 60, wherein an acid value of the polymer, after washing with the basic solution differs from the acid value of the polymer prior to the washing by less than about 10%.
- 15 62. The composition of claim 60, wherein one or more peaks measured in an infrared spectrum of the composition attributable to free acid content are reduced in peak height by less than about 20% compared to the same peaks in an infra red spectrum of the composition measured essentially the same way after the composition has been devolatilized by heating at 180°C for 30 minutes.
- 20 63. A process of making the composition of claim 1, comprising the steps of:
- 25 1) combining monomer, optional solvent, catalyst and activator in a reactor system;
- 2) withdrawing olefin polymer solution from the reactor system, where the polymer comprises at least 50 mol% of one or more C3 to C40 olefins
- 30 and has:
- a) a Dot T-Peel of 1 Newton or more on Kraft paper;
- b) an Mw of 10,000 to 100,000; and
- c) a branching index (g') of 0.98 or less measured at the Mz of the polymer when the polymer has an Mw of 10,000 to 60,000, or a branching index (g') of 0.95 or less measured at the Mz of the polymer when the polymer has an Mw of 10,000 to 100,000;

- 3) removing at least 10% solvent, if present, from the olefin polymer solution;
  - 4) quenching the reaction;
  - 5) devolatilizing the olefin polymer solution to form molten olefin polymer;
  - 6) combining at least a portion of the molten olefin polymer with an functional group in the presence of a radical initiator at a temperature, and for a period of time sufficient to produce molten functionalized olefin polymer;
  - 7) combining the molten functionalized polymer, the olefin polymer, and optionally one or more additives in a mixer and mixing to produce a composition;
  - 8) removing the composition from the mixer, and
  - 9) pelletizing or drumming the composition.
64. A surface primer comprising the composition of claim 1.
65. A tie layer comprising the composition of claim 1.
66. An adhesion promoter comprising the composition of claim 1.
67. A hot melt adhesive comprising the composition of claim 1.
68. A compatiblizer comprising the composition of claim 1.